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GREGORY M. TAYLOR
WORKMAN, NYDEGGER & SEELEY
1000 EAGLE GATE TOWER
60 EAST SOUTH TEMPLE
SALT LAKE CITY, UT 84111

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CAO, PHAT X	

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BEFORE THE BOARD OF PATENT APPEALS AND INTERFERENCES

Paper No. 0104

Application Number: 09/293,188
Filing Date: April 16, 1999
Appellant(s): YIN ET AL.

Gregory M. Taylor
For Appellant

EXAMINER'S ANSWER

This is in response to the appeal brief filed 10/27/2003.

(1) Real Party in Interest

A statement identifying the real party in interest is contained in the brief.

(2) Related Appeals and Interferences

There are no related appeals or interferences.

(3) Status of Claims

The statement of the status of the claims contained in the brief is correct.

(4) Status of Amendments After Final

All amendments have been previously entered.

(5) Summary of Invention

The summary of invention contained in the brief is correct.

(6) Issues

The appellant's statement of the issues in the brief is correct.

(7) Grouping of Claims

Appellant's brief includes a statement that claims 1-2, 9-10, 15-16, and 29-30 stand or fall together. And claims 7-8 and 17-20 stand or fall together.

(8) Claims Appealed

The copy of the appealed claims contained in the Appendix to the brief is correct.

(9) Prior Art of Record

U.S. 5,780,908	SEKIGUCHI ET AL.	07-1998
U.S. 6,077,774	HONG ET AL.	06-2000
U.S. 6,114,238	LIAO	09-2000

(10) Grounds of Rejection

The following ground(s) of rejection are applicable to the appealed claims:

Claim Rejections - 35 USC § 103

I. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

II. Claims 1-2, 7-10, 15-20 and 29-30 are rejected under 35 U.S.C. 103(a) as being unpatentable over Sekiguchi et al (US. 5,780,908) in view of Hong et al (US. 6,077,774).

Sekiguchi et al disclose in Fig. 3(b) a semiconductor structure comprising: an electrically conductive interconnect disposed within a first dielectric layer 4, the electrically conductive interconnect having an upper surface and including: a titanium/titanium nitride bilayer film 6 disposed within a depression in the first dielectric layer 4; a tungsten film 7 disposed upon the titanium/titanium nitride bilayer film 6 and filling the depression; a passivation layer 7b of tungsten nitride layer, disposed upon the upper surface and having a thickness of less than 50 angstroms (column 16, lines 20-24), the passivation layer 7b formed by exposing the surface of the tungsten interconnect 7 to plasma in an atmosphere of ammonia (NH3) for nitriding an area in the vicinity of the surface of the tungsten interconnect 7 (column 15, lines 50-58), wherein the plasma in an atmosphere of ammonia allows ions of ammonia (NH3) to enter the tungsten interconnect 7 (column 11, lines 28-35). Therefore, the passivation layer 7b of

tungsten nitride (WN) would inherently include hydrogen ions (H) from the ammonia source gas to form the chemical structure W-N-H (claim 1). It is noted that a first passivation layer comprising tungsten nitride and a second passivation layer comprising ammonia as claimed in claims 7, 17, 19 and 30 do not distinguish from the passivation layer 7b of tungsten nitride comprising ammonia derivatives (N and H) of Sekiguchi which can be arbitrarily subdivided into numerous sub-layers about each other. It is also noted that because the passivation layer 7b of tungsten nitride in the vicinity of the surface of the interconnect (column 12, lines 29-37) is formed to a thickness of several nm for functioning as a barrier layer (column 11, lines 33-35), the passivation layer 7b would inherently chemically protect at least one atomic lattice layers of the interconnect.

Sekiguchi et al do not disclose an inter-layer dielectric (ILD) disposed upon the first dielectric layer 4 and being continuously adhered to the upper surface.

However, Hong et al teach in Fig. 1F the forming of an ILD 36 upon the dielectric layer 12 and continuously adhered to the upper surface of the electrically conductive interconnect 30. Accordingly, it would have been obvious to form an ILD upon the dielectric layer 4 and continuously adhered to the upper surface of the electrically conductive interconnect 7 of Sekiguchi, because the ILD would function as a passivation layer for the known purpose of isolating and protecting the electrically conductive interconnect from the outside ambient. Note that process limitations (i.e., forming by Brunauer's Type V adsorption, forming by exposing to a plasma consisting essentially of a nitrogen-containing silane) do not lend patentability to a claim drawn to structure unless unexpected properties are demonstrated. In re Thorpe, 227 USPQ 964 (Fed. Cir. 1985).

III. Claims 1-2, 7-10, 15-20 and 29-30 are rejected under 35 U.S.C. 103(a) as being unpatentable over Sekiguchi et al in view of Liao (US. 6,114,238).

As discussed above, Fig. 3(b) of Sekiguchi et al substantially reads on the above claims, except it does not disclose an ILD disposed upon the first dielectric layer and being continuously adhered to the upper surface of the conductive interconnect.

However, in view of Fig. 1 of Liao, it would have been obvious to form an ILD upon the dielectric layer 4 and continuously adhered to the upper surface of the conductive interconnect 7 of Sekiguchi, because the ILD would function as a passivation layer for the known purpose of isolating and protecting the electrically conductive interconnect from the outside ambient.

(11) Response to Argument

I. ISSUE NO. 1: Whether claims 1-2, 7-10, 15-20 and 29-30 are obvious over Sekiguchi et al in view of Hong et al.

A) Independent claim 1

a) Regarding claim 1, Appellant (page 4 of brief, second paragraph) argues that Sekiguchi does not suggest the passivation layer comprising "the chemical structure M-N-H, where M represents the metal of the interconnect".

This argument is not persuasive because of the following reasons:

- first, Sekiguchi clearly discloses a passivation layer comprising the chemical structure of M-N-H. Specifically, Sekiguchi (Fig. 3b) discloses the passivation layer 7b of tungsten nitride (WN) disposed upon the upper surface of a tungsten interconnect 7. The passivation layer 7b is formed by exposing the surface of the

tungsten interconnect 7 to plasma in an atmosphere of ammonia (NH3) for nitriding an area in the vicinity of the surface of the tungsten interconnect 7 (column 15, lines 50-58), wherein the plasma in an atmosphere of ammonia **allows ions of ammonia (NH3) to enter the surface of tungsten interconnect 7** (column 11, lines 28-35). Therefore, the passivation layer 7b of tungsten nitride (WN) would inherently include hydrogen ions (H) from the ammonia source gas and form the chemical structure W-N-H (or M-N-H) (W is tungsten; N is nitrogen; H is hydrogen; and M is generally a metal);

- second, Sekiguchi discloses the forming of the passivation layer 7b which appears to be produced by **substantially identical processes** as disclosed by Appellant (i.e., nitriding the conductive interconnect in ammonia atmosphere) (see Appellant's specification, second paragraph of page 10). Therefore, the passivation layer of Sekiguchi and the passivation layer of Appellant must have the same chemical structure because they are both produced by identical processes;

- and third, once a reference teaches product appearing to be substantially identical and the examiner presents evidence or reasoning tending to show inherency, the burden shifts to Appellant to show an unobvious difference. *In re Fitzgerald*, 205 USPQ 594 (CCPA 1980). In this case, the examiner has presented reasoning tending to show that the passivation layer 7b of tungsten nitride (WN) would inherently comprise hydrogen ions (H) of ammonia for forming the chemical structure W-N-H. However, Appellant fails to provide any evidence to support that the passivation layer 7b disclosed by Sekiguchi is different from the passivation layer as claimed.

Regarding claim 1, Appellant (page 4 of brief, second paragraph) further argues that Sekiguchi does not suggest "the passivation layer substantially covers the upper surface of the interconnect in order to chemically protect about 1-1,000 atomic lattice layers thereof".

This argument is not persuasive. It should be noted that the claim is broadly states that about **one** or more lattice layers of the interconnect (i.e., 1-1,000 atomic lattice layers) is protected. The passivation layer 7b of Sekiguchi is formed by a chemical reaction with the top surface of the interconnect 7 to form a chemical compound in the vicinity of the surface of the interconnect 7 to a thickness of several nm for functioning as a barrier layer (column 11, lines 28-35). Therefore, because the passivation layer 7b has a thickness of several nm and functions as a barrier layer, the passivation layer 76 chemically protects **at least one** atomic lattice layer of the interconnect 7.

B) Independent claims 7-9, 15-17, 19, 29 and 30

Regarding claims 7-9, 15-17, 19, 29 and 30, Appellant (page 4 of brief, second paragraph) again argues that Sekiguchi does not suggest the passivation layer chemically protects about 1-1,000 atomic lattice layers of the interconnect.

As already discussed above, Sekiguchi does suggest the recited features for the passivation layer. Again, It should be noted that these claims merely state that about **one** or more lattice layers of the interconnect (i.e., 1-1,000 atomic lattice layers) is protected. In this case, the passivation layer 7b of Sekiguchi is formed by a chemical

reaction with the top surface of the interconnect 7 to form a chemical compound in the vicinity of the surface of the interconnect 7 to a thickness of several nm for functioning as a barrier layer (column 11, lines 28-35). Therefore, because the passivation layer 7b has a thickness of several nm and functions as a barrier layer, the passivation layer 76 chemically protects **at least one** atomic lattice layers of the interconnect 7.

C) Independent claims 7, 17 and 19

Regarding claims 7, 17 and 19, Appellant (page 4 of brief, third paragraph) argues that Sekiguchi does not suggest a stack of passivation layers comprising a second passivation layer having "multiple layers of nitrogen compounds adsorbed upon said first passivation layer according to Brunauer's Type V adsorption."

Appellant's argument is not persuasive because it should be noted that these claims are directed to the product, no matter how it is actually made, and the patentability of the final product must be determined, not the patentability of the process, which in any case have not been presented in "product by process" claims. *In re Thorpe*, 227 USPQ 964 (Fed. Cir. 1985). In this case, the process of performing "Brunauer's Type V adsorption" does not carry weight in a claim drawn to structure. Therefore, it does not matter how the passivation layer of the present invention is actually made. However, in the final structure, the passivation layer comprising a stack of first and second passivation layers as claimed does not distinguish from the passivation layer 7b of tungsten nitride comprising ammonia derivatives (N and H) of

Sekiguchi which can be arbitrarily subdivided into numerous sub-layers about each other.

D) Independent claim 8

Regarding claim 8, Appellant argues that Sekiguchi does not suggest a passivation layer comprising "nitrogen adsorbed upon said upper surface according to Brunauer's Type V adsorption."

This argument is not persuasive because as already discussed above, the process of performing "Brunauer's Type V adsorption" does not carry weight in a claim drawn to structure. Therefore, Sekiguchi does suggest a passivation layer 7b comprising nitrogen adsorbed upon the upper surface of tungsten interconnect 7 because the passivation layer 7b of tungsten nitride (WN) is formed by exposing the surface of the tungsten interconnect 7 to plasma in an atmosphere of ammonia (NH3) for nitriding an area in the vicinity of the surface of the tungsten interconnect 7 (column 15, lines 50-58).

II. ISSUE NO. 2: Whether claims 1-2, 7-10, 15-20, and 29-30 are obvious over Sekiguchi et al in view of Liao.

A) Independent claim 1

a) Regarding claim 1, Appellant (page 5 of brief, second paragraph) argues that Sekiguchi does not suggest the passivation layer comprising "the chemical structure M-N-H, where M represents the metal of the interconnect".

This argument is not persuasive because of the following reasons:

- first, Sekiguchi clearly discloses a passivation layer comprising the chemical structure of M-N-H. Specifically, Sekiguchi (Fig. 3b) discloses the passivation layer 7b of tungsten nitride (WN) disposed upon the upper surface of a tungsten interconnect 7. The passivation layer 7b is formed by exposing the surface of the tungsten interconnect 7 to plasma in an atmosphere of ammonia (NH3) for nitriding an area in the vicinity of the surface of the tungsten interconnect 7 (column 15, lines 50-58), wherein the plasma in an atmosphere of ammonia **allows ions of ammonia (NH3) to enter the surface of tungsten interconnect 7** (column 11, lines 28-35). Therefore, the passivation layer 7b of tungsten nitride (WN) would inherently include hydrogen ions (H) from the ammonia source gas and form the chemical structure W-N-H (or M-N-H) (W is tungsten; N is nitrogen; H is hydrogen; and M is generally a metal);

- second, Sekiguchi discloses the forming of the passivation layer 7b which appears to be produced by **substantially identical processes** as disclosed by Appellant (i.e., nitriding the conductive interconnect in ammonia atmosphere) (see Appellant's specification, second paragraph of page 10). Therefore, the passivation layer of Sekiguchi and the passivation layer of Appellant must have the same chemical structure because they are both produced by identical processes;

- and third, once a reference teaches product appearing to be substantially identical and the examiner presents evidence or reasoning tending to show inherency, the burden shifts to Appellant to show an unobvious difference. *In re Fitzgerald*, 205 USPQ 594 (CCPA 1980). In this case, the examiner has presented reasoning tending

to show that the passivation layer 7b of tungsten nitride (WN) would inherently comprise hydrogen ions (H) of ammonia for forming the chemical structure W-N-H. However, Appellant fails to provide any evidence to support that the passivation layer 7b disclosed by Sekiguchi is different from the passivation layer as claimed.

Regarding claim 1, Appellant (page 5 of brief, second paragraph) further argues that Sekiguchi does not suggest "the passivation layer substantially covers the upper surface of the interconnect in order to chemically protect about 1-1,000 atomic lattice layers thereof".

This argument is not persuasive. It should be noted that the claim is broadly states that about **one** or more lattice layers of the interconnect (i.e., 1-1,000 atomic lattice layers) is protected. The passivation layer 7b of Sekiguchi is formed by a chemical reaction with the top surface of the interconnect 7 to form a chemical compound in the vicinity of the surface of the interconnect 7 to a thickness of several nm for functioning as a barrier layer (column 11, lines 28-35). Therefore, because the passivation layer 7b has a thickness of several nm and functions as a barrier layer, the passivation layer 76 chemically protects **at least one** atomic lattice layer of the interconnect 7.

B) Independent claims 7-9, 15-17, 19, 29 and 30

Regarding claims 7-9, 15-17, 19, 29 and 30, Appellant (page 5 of brief, second paragraph) again argues that Sekiguchi does not suggest the passivation layer chemically protects about 1-1,000 atomic lattice layers of the interconnect.

As already discussed above, Sekiguchi does suggest the recited features for the passivation layer. Again, It should be noted that these claims merely state that about **one** or more lattice layers of the interconnect (i.e., 1-1,000 atomic lattice layers) is protected. In this case, the passivation layer 7b of Sekiguchi is formed by a chemical reaction with the top surface of the interconnect 7 to form a chemical compound in the vicinity of the surface of the interconnect 7 to a thickness of several nm for functioning as a barrier layer (column 11, lines 28-35). Therefore, because the passivation layer 7b has a thickness of several nm and functions as a barrier layer, the passivation layer 76 chemically protects **at least one** atomic lattice layers of the interconnect 7.

C) Independent claims 7, 17 and 19

Regarding claims 7, 17 and 19, Appellant (page 5 of brief, third paragraph) argues that Sekiguchi does not suggest a stack of passivation layers comprising a second passivation layer having "multiple layers of nitrogen compounds adsorbed upon said first passivation layer according to Brunauer's Type V adsorption."

Appellant's argument is not persuasive because it should be noted that these claims are directed to the product, no matter how it is actually made, and the patentability of the final product must be determined, not the patentability of the process, which in any case have not been presented in "product by process" claims. *In re Thorpe*, 227 USPQ 964 (Fed. Cir. 1985). In this case, the process of performing "Brunauer's Type V adsorption" does not carry weight in a claim drawn to structure. Therefore, it does not matter how the passivation layer of the present invention is

actually made. However, in the final structure, the passivation layer comprising a stack of first and second passivation layers as claimed does not distinguish from the passivation layer 7b of tungsten nitride comprising ammonia derivatives (N and H) of Sekiguchi which can be arbitrarily subdivided into numerous sub-layers about each other.

D) Independent claim 8

Regarding claim 8, Appellant argues that Sekiguchi does not suggest a passivation layer comprising "nitrogen adsorbed upon said upper surface according to Brunauer's Type V adsorption."

This argument is not persuasive because as already discussed above, the process of performing "Brunauer's Type V adsorption" does not carry weight in a claim drawn to structure. Therefore, Sekiguchi does suggest a passivation layer 7b comprising nitrogen adsorbed upon the upper surface of tungsten interconnect 7 because the passivation layer 7b of tungsten nitride (WN) is formed by exposing the surface of the tungsten interconnect 7 to plasma in an atmosphere of ammonia (NH3) for nitriding an area in the vicinity of the surface of the tungsten interconnect 7 (column 15, lines 50-58).

For the above reasons, it is believed that the rejections should be sustained.

Respectfully submitted,

PC
January 6, 2004

PHAT X. CAO
PRIMARY EXAMINER

Conferees

Olik Chaudhuri OC Supervisory Patent Examiner (Tech 2800)

Wael Fahmy W.F Supervisory Patent Examiner (Tech 2800)

Phat X. Cao PC Primary Examiner (Tech 2800)

Gregory M. Taylor
1000 EAGLE GATE TOWER
60 EAST SOUTH TEMPLE
SALT LAKE CITY, UT 84111